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Electric Motors.

LETTERS PATENT to Edward Henry Cradock Monckton, of Fineshade, Northamptonshire, for the Invention of "IMPROVEMENTS IN GENERATING AND APPLYING THE ELECTRIC CURRENT AND IN PRODUCING MOTIVE POWER, AND IN THE APPARATUS NECESSARY FOR CARRYING THE SAME INTO EFFECT."

Sealed the 23rd February 1877, and dated the 28th November 1876.

COMPLETE SPECIFICATION filed by the said Edward Henry Cradock Monckton at the Office of the Commissioners of Patents on the 28th November 1876.

EDWARD HENRY CRADOCK MONCKTON, of Fineshade, Northamptonshire. "IM-
5 PROVEMENTS IN GENERATING AND APPLYING THE ELECTRIC CURRENT AND IN
PRODUCING MOTIVE POWER, AND IN THE APPARATUS NECESSARY FOR CARRYING THE
SAME INTO EFFECT."

Firstly. I construct complete magnetic circles of either permanent or electro
horse-shoe magnets with their coils joined together by placing them in juxta-
10 position round two circular frames, each pole of each magnet being consecutively
placed so as to face the opposite pole of the next magnet, thus, N to S and S to N
all round; this is effected either by placing the magnets laid flat round the
peripheries of the frames or by bending the magnets or by making them in pieces
to be joined together in any desired form, so as to be arranged vertically with their
15 poles turned aside. By making the magnets flat instead of round they can be
packed closer, the same consecutive polar arrangement being made. By separating
the poles a sufficient distance one or more plain iron or magnetised steel discs can
be introduced packed side by side almost in contact, which arrangement will also
unite into one large magnet the entire circle of smaller ones. These discs can be
20 arranged so as to revolve in any way desired, they may also be made to break
contact by being slotted from the circumference towards the middle. By sub-
stituting for this disc an electro-magnet formed like a reel with slotted ends or poles
or in lieu of it a revolving wheel formed of electro-magnets, both wheels being
insulated from their axles, and by revolving either in contact with the poles of the
25 magnets arranged in circles, as above described, the electro-magnetic circles will be
alternately completed and broken, and by a suitable arrangement any current
generated can be drawn off.

[Price 8d.]

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Secondly. I construct all my circular electro-magnets by coiling insulated wire with thin sheet iron interposed between every successive two or more coils over a hollow central iron tube; by preference the two polar ends of this tube are made very large, somewhat resembling those of a reel for winding thread on, except that they are by preference dished or carved, either outwardly, so that their rims or edges project outwardly beyond the centre of the magnet tube, or inwardly, so as to pass over the top of the coil and to face inwards towards its centre, and thus the two magnetic poles are formed cup-shaped; these polar discs or cups are by preference slotted, so that as they pass the poles of the magnets forming the circles, they alternately unite them into one complete circle and disunite them. Where I use a series of electro-magnets, I unite by preference the coils on them from magnet to magnet so as to form one complete circle of magnetic coils, and in this manner I form two distinct and complete magnetic circles, the one fixed, the other rotating; the poles of such magnetic circles can be changed by using proper commutators.

Thirdly. I vary the form of ordinary permanent and electro horse-shoe magnets by curving their ends inwards so as to make them face each other, and by applying to them my novel bowl-shaped poles dished by preference inwardly, by which means the magnetic force is caused to lie chiefly in the outward edges or rims of the bowls and less in their centres which are least prominent, and I also when desired cut slots in the edges or rims to these bowls, so as to cut off magnetic contact at those parts. I cause my globular magnet above described to revolve with its semi-circular poles curved inwards facing and lying within the hemispherical poles of a large magnet so constructed, the axle being arranged so as to pass through the centre of the former and between the poles of the latter, and I vary this construction by making the poles of the large magnet curved hollow and shaped semi-cylindrically, and the rotating magnet with each of its poles curved round semi-cylindrically, so that they can rotate within the former.

Fourthly. I attach also straight or curved electro or permanent magnets, as the case may be, by their centres in a circle round the periphery of a metallic disc or ring, making them to face outwardly in the former and inwardly in the latter case, and I also insert their ends circularly into the sides of discs, uniting their coils together all round, and thus form a complete magnetic circle. I further construct a novel form of engine by placing a fixed circular or other shaped electric fluid reservoir or condenser between two electro-magnet cylinders, each rotating opposite to a similar fixed magnet circle, the axletree common to both passing through its centre; these rotating magnets are arranged with their commutators so that their poles attract those of the magnets attached to the fixed circles, while simultaneously the poles of the magnets on the rotating circle repel the poles of the magnets attached to the fixed circle placed opposite to them; just as the poles are passing the centres of attraction, a rotating commutator changes the direction of the current, and those magnets which before attracted now repel, while those that previously repelled now attract, so that by this means the power is applied continuously all round the circle, one commutation serving for each entire circle. The poles may be similarly changed and with the same effect on each circle. In addition to the condenser I sometimes add an intensity coil, so that the currents from the battery have to pass first through the condenser and then through the tension coil prior to entering the magnets, the condenser acting as a reservoir already charged from the battery, while the tension coil gives to the current the degree of intensity calculated to produce the best and strongest effect on magnets always in the closest possible proximity. It must be borne in mind that we are here dealing with a power vastly different from ordinary mechanical ones, and that the velocity produced by intensifying the current is in its own action an element of great power, especially where the magnet poles as in the present instance are always in the closest possible approximation.

Fifthly. I further improve the above construction by causing the poles of each magnet to act doubly, that is, to attract at the one side while repelling at the other side, which I effect by placing the circle of rotating horse-shoe magnets with their



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poles opposite to those of the fixed ones, in such a position that half their poles is simultaneously attracting while the other half of their poles is simultaneously repelling one the other, whereby loss of power is rendered impossible, all back pull is avoided, and the electro-magnetic force is exercising simultaneously attraction and
5 repulsion to its fullest possible extent. The method of effecting this will be easily understood by a reference to Fig. 24, and its explanation.

Sixthly. By preference I use circular condensers, which I construct by coiling together two strips of tin or other suitable foil with a non-conducting material, as varnished silk or paper interposed, the sides of the foils forming the poles being
10 made to project on either side where they are afterwards united together, or else I use plumbago applied to paper; the foil and paper by being previously wound on to reels affords great facility for their construction. I construct induction coils in a similar manner with thin sheet iron interposed between these foils with a non-conducting material placed between, such as paper and silk sulphurised by my
15 patent processes, and apply them as substitutes for coils in electro-magnets, which method gives greater facility for construction, I also wind the foils and paper as above described, but without allowing them to come in contact by projecting on either side, and as they are coiled I insert pieces of foil or wire on each side so as to act as to be united and to form conductors, thereby saving a great and needless
20 expenditure of foil.

Seventhly. I make carbon points and slips for burning in order to produce the electric light, and also for the construction of carbon crucibles and crucible linings for experimental purposes and for electrodes and porous cells, by uniting together pulverized carbon with clay in sufficient quantity to bind it. I prefer to use where
25 procurable the purest clays, such as the Cornwall and other China clays; these mixtures I also subject by preference to hydraulic pressure previous to being baked. I further combine clay and plumbago with powdered carbon and metallic filings, precipitates, or deposits, or powdered minerals in the same manner, in order to effect certain objects.

Eighthly. I cause the wheels of locomotives to bite or adhere more firmly to the rails by attaching powerful electro-magnets, horse-shoe by preference, to their frames, with their poles placed in close proximity along the surface of rails, and in order to prevent accidents by contact with rough surfaces I apply small iron rollers or wheels to the poles, so that on touching they can run over instead of scraping
35 along the rail; the axles of these wheels are fixed, by preference, into small iron frames that can move up and down in slots cut in the magnet, so that they would instantly rise if they met with any inequality in the rails. These frames are pressed down by small coiled springs. I effect the same purpose by simply causing the magnet itself to play up and down at the points of attachment to the carriage,
40 small bevelled guards being placed in front and rear of the magnet arms, so that on meeting any obstacle these guards would slide on to it and cause the magnet to rise.

Ninthly. I further cause the wheels to bite the rails by making reel electro-magnets, as already described, on a large scale, these I fix across the locomotive
45 frame so that their circular ends or poles which are in this case dished somewhat outwards by preference and not slotted shall run the one on the one rail, and the other on the other rail; the peripheries of these poles are by preference formed like locomotive wheels, and are secured to and made to rotate round the ends of the bar magnet which here forms their axle, and which is in this case stationary. I
50 apply electricity however generated to magnetise these coils, these magnetic reels may, if preferred, be arranged so as to revolve, their dished ends or wheels being in this case fixed on to the magnet bar or tube instead of being loose. Another advantage resulting from the having the dished poles or wheels constructed as above is that the flange of the wheel forming one piece with the periphery gives a con-
55 siderably larger attracting surface than where the periphery without any flange alone attracts, for it can only do so at one point. Where steel rails are used I magnetize them by running magnetized wheels over them, by which means they

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soon acquire polarity and become permanent magnets, and when their ends are cut diagonally and they are properly and continuously laid they aid themselves in attracting the wheels to them; I further magnetize rails prior to laying them down.

Tenthly. In all cases I construct my electro-magnets, by preference, however 5 they may be applied with thin sheets of iron interposed between one, two, or more insulated wire coils which are lapped over at the ends in order to take up all latent electricity in the coil, as described in my previous Patents. The dished or bowl ends of these magnets I secure, by preference, afterwards on to the magnet bar by screws or otherwise, by which arrangement the winding of the coils and the placing 10 them on the magnet arms previously so prepared in separate pieces is greatly facilitated.

Eleventhly. In lieu of magnetic reels, as above described, I also use revolving magnet cylinders constructed with small, straight, or horse-shoe magnets formed on the same principle as those on the outer fixed circle, and by this means I am able 15 more easily to balance as much as possible the attractive magnetic force or power of the outer fixed circle of magnets against that of the inner magnetic revolving wheel, placing magnets of equal or nearly equal power against each other. Another advantage that I gain by using small magnets is, that metal suitable for their construction is more easily procured, they are also cheaper to work, handle, and coil, 20 and when united produce the same effect as large ones, besides which they can be more easily repaired, separated, carried about, and joined together again. To enable magnets to pack closely round my cylinders and wheels, whether fixed or rotating, I by preference make them flat and broad so that the coils can thus lie flat and occupy less space than they would if coiled on round magnets, and I 25 further place flat and wide straight magnets round this wheel and connect their poles on each side together, so that the whole of the north poles are united into one, and the south poles into one by means of flat iron or steel rings, and I connect their coils also where desired.

Twelfthly. I construct my propelling wheels for locomotives on railways with 30 and without expansion spokes and tyres, in such a manner as to admit of their biting the rails over a largely extended surface, and I further lay down a broad central road of stone, iron, or other suitable material specially for these wheels, which I construct of as great a size and diameter as the space will admit of; I apply the electric current or not at pleasure to these wheels. The construction of 35 the wheel with expanding tyre is as follows:—Round a central metallic core forming the base into which the axle box is inserted are secured pairs of spokes made of thin flat pieces of plate steel which are fixed in contact with each other, their ends being secured by means of clips, as shown in Figs. 14 and 15 respectively, to the periphery or tyre and the central core; these pieces of steel when 40 separated at their centres and curved outwards from the elastic spokes. The periphery or tyre into which these spokes are inserted and fixed is also constructed of plate steel, these all, both tyre and spokes, being properly tempered act as springs; the elastic tyre yielding to the pressure on the axle contracts vertically and expands horizontally, thus forming an oval or ellipse, while the spokes yielding to the 45 pressure take all round the form assumed by the tyre, and either separate centrally still further or approach closer to each other; as they are they become placed in either a vertical or horizontal position by turning the wheel, when some of them will be forced together lengthways and become nearly if not quite straight, closely approaching each other; while those in a vertical position will have their sides 50 curved outwards and be separated according to the force of pressure applied almost into circles; the wheel itself when not weighted will be circular and the spokes equally curved out, the spaces between them being equidistant, or nearly so, from each all round. By increasing the diameters of these wheels and the breadth of their tyre the surface of their bite on existing rails or on my proposed new 55 central road will be very great without the application to them of electricity. I also apply these expansion wheels for attracting the rails instead of using dished poles

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or common wheels to my electro-magnetic wheels above described; where I do not use expansion wheels for propelling I use large cylindrical wheels made of iron or of iron and wood, or paper; these have their peripheries surrounded by cords made in the ordinary way, or with lengths of solid or tubular vulcanized india-rubber
5 coiled round or across the tyre; these cylinders are made of the greatest possible width and diameter so as to occupy a large road surface, and thus reduce the friction on any part of the wheel's circumference to a minimum.

Thirteenthly. I make electrical wire brushes for curative purposes, and for giving a healthy tone and action to the body. I prefer however to make them circular
10 and rotating in the manner now applied to brushing hair, and to brushing horses and other animals, though they may be made of any other shape and be applied for this object in any suitable manner; these brushes being insulated one pole of the battery is applied by preference to the metallic centre to which the wire forming the brush is attached, while the other pole is applied to some part of the animal, as
15 to, say, its leg; by this means the animal is not only groomed but is simultaneously subjected to the curative and strengthening influence of the electric current. The same system can be applied to the human frame, the brushes being made finer and the wire forming these brushes being in this case by preference electro-plated.

Fourteenthly. I further apply electricity to the human body by conveying it in
20 the first instance through the bodies of healthy animals, say, for example, through the bodies of a series of cows or horses insulated, on boards or otherwise. I also do the same through the bodies of healthy persons, substituting them for animals. The pole on one side of the battery is connected with a row or chain of animal or human bodies, and thence with the brush or plate, or is conveyed from the animals to the
25 body of a healthy person, who would then form the end of this animal chain, and who may apply his hand, if preferred, or the brush or plate in lieu of the hand, as the case may be, to the part of the patient's body affected, who is placed either in direct communication with the other pole, or, if preferred, with another similar animal chain similarly arranged, and interposed between him and the battery pole
30 on the other side.

Fifteenthly. I further convey the electrical current to the human body after passing it through medicinal baths of various sorts, such as solution of iron and steel, with or without the introduction of the animal chain above described.

Sixteenthly. I use to produce a current an improved form of annular coiled
35 magnet as follows:—On a ring, composed either of soft iron or of coiled iron wire, I coil at right angles to it a layer of insulated copper wire round a section of it, and interpose between each layer of coil or between 3 or 4 layers of coil a very thin sheet of iron, the thickness of paper; and over this section I continue to wind round it another layer or coil or a few layers or coils of the same wire, and place over it
40 another fold of thin sheet iron, and so on alternate layers of insulated wire and folds of sheet iron continuously till I have obtained the thickness required for one section. I thus make as many sections as are desired to complete the circle, and I finish off by preference by placing a thin casing of iron so as to cover the wire. This ring, the wire coiled on which is continuous, as all the sections are joined up, I
45 use as a substitute for and an improvement on the magnetic ring as now prepared in Gramme's electro-magnetic machine, and I apply it with the same object and in the same way, the wires from each section being placed in connection with the commutator or break in the same manner. The improvements consist, firstly, in causing all the electric current latent in the coils to be taken up by means of the
50 sheet iron interposed; and, secondly, in causing the iron forming this circular ring magnet to rotate in close proximity with the poles of the fixed one, which in Gramme's magnetic ring cannot be effected except at a considerable disadvantage, owing to the interposition of the entire thickness of the copper wire coil between the iron wire magnetic coil lying within it and the poles of the magnet without.

Seventeenthly. I make use of the following improved method of commutating
55 and reversing the poles of the coils on electro-magnets and batteries for generating electro-magnetism by placing two metal rings, say, of brass, one on each side of

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a drum or cylinder made of non-conducting material, such as wood. Across the top of the periphery of this drum immediately between these metal rings are placed wires or pins, which are by preference inserted into the periphery of the drum, so as to lie flat and evenly with its surface. These wires are made to alternate the one with the other, the one proceeding from the metal ring on one side so as to approach the metal ring on its opposite side, but leaving a space between them, the next wire or pin being similarly made to come from this last ring and approach without touching the first one, and so on alternately all round. The terminals of a coil on an electro-magnet are then inserted apart into a frame of non-conducting material, which is fixed over this revolving disc so that the terminals of the coils on the magnets as they rotate come in contact simultaneously with two of these alternate pins or wires, negative and positive, lying across the periphery of the drum, and thus the poles are alternately changed, and an electric current is produced. I prefer to adopt this method where batteries or substitutes for them are used, as by the facility afforded for rapidly changing the poles, as well as by the close approximation of the magnet's poles, the entire electric current is utilised.

Eighteenthly. I further improve the induction of my electro-magnetic machine, see Figures 13 and 20, by introducing a circular commutator on the outer edge of the axle supporting the rotating magnet, in addition to and on the same construction and principle as the commutator which I place round this latter; this in communication with the terminals of the coil on the fixed magnet, so that this commutator also in rotating causes an instantaneously consecutive commutation of the current to and from the poles of the fixed magnet, so that by passing the current consecutively or simultaneously, as the case may be, through both magnets a greater magnetic induction as well as a more continuous flow of the electric current is produced. I further rotate my bar reel electro-magnet with semicircular poles curved inwardly over the coil between the semiglobular poles of a fixed permanent or electro-magnet placed facing, so that the coil on the rotating magnets is always at right angles to the poles of the fixed magnets, the axle of the former being secured to it at right angles to the centre of the magnet bar, and passing through the centre of its coil.

Nineteenthly. I employ air and water in proportion of about 30 parts by space of air to from 2 to 5 of water forced simultaneously by pumps through a fine wire gauze into a tubular, by preference, receiver, where they come in contact in a vaporous form with red-hot platinum heated by a current generated by a battery or a magneto-electric or thermo-electric apparatus, or otherwise, and utilize it for communicating power to an engine. I further employ similarly a mixture of air, coal gas, and vapour from water, and use the electric spark.

DESCRIPTION OF THE DRAWINGS.

Fig. 1, W, W, represents a section through two circular frames attached to a stand S, S, S, S, surrounded by either permanent or electro-magnets 1, 2, 3, 4, 5, 6, &c. A is the axle formed of metal, and runs on an insulated bearing I, I, attached to these frames and stand.

Figure 2 represents an outside or bird's-eye view from above of W, W, Fig. 1. Here 1, 2, 3, 4, 5, 6, &c., represents permanent magnets arranged round their respective frames F, F, F, F, and F, F, F, F,—D, d, d, d, d; D represents a circular iron disc referred to above, which is secured to the axle A, B, and insulated from it at I, I, Fig. 1. The circular frames sustaining the magnets are also insulated from the stand, and the stand from the ground. The magnets 1, 2, 3, 4, 5, 6, &c., are so arranged that their poles are placed N and S, and S and N consecutively, so as to form a continuous magnetic circle from magnet to magnet, all round the wheel. The discs D, d, d, d, d, D, revolves almost in contact between these two circular frames of magnets, so as to enter between and unite in one their respective poles, illustrating a new principle of construction.

Figs. 3 and 4 show another form of constructing the same machine. Here the

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magnets 1, 2, 3, 4, 5, 6, &c., instead of being placed respectively on separate frames W, W, are placed diagonally, connecting the two frames, so that the poles of the magnets 1, 2, 3, 4, 5, 6, &c., are placed consecutively S N, S N, S N, S N. The poles may also be turned sideways, or be constructed so as to carry out this arrangement in a variety of ways, the disc D, *d, d, d, d, D*, Fig. 2, revolving between them, and connecting all their poles into one complete magnetic circle, which is made to take the place of the above iron disc.

Fig. 5 shews a circular electro-magnet, C, C, being an insulated coil wound round a thick iron tube secured to but by preference insulated from its axle A, B, by insulating material, as shown at I, I, I, I; this iron tube with its coil on it has two iron cups *a, a, a, a*, and *a, a, a, a*, secured one to each end at I, I, I, I, which form the magnetic poles. Surrounding the margins of these cups are rims *p, p*, and *p, p*, which revolve within the poles *a, a, a, a*, see Fig. 6, of the circle of magnets or electro-magnets as they may happen to be in lieu of the iron disc. H represents a handle for turning the disc.

Fig. 6 represents the same form of construction as Fig. 5, only that the cups *a, a, a, a*, and *a, a, a, a*, forming the poles are turned so as to face inwards instead of outwards, the pins or poles consequently are placed much nearer together and the machine so constructed occupies much less space.

Fig. 7 represents the magnets M, M, M, M, &c., placed round a frame not drawn, their poles placed as above described running N S, N S, N S, N S, consecutively all round, with the addition of two iron or steel rings A, A, A, A, A, &c., and B, B, B, B, B, &c., uniting into one their respective poles, so that these rings throughout their circles act also as magnetic mediums, while leaving an annular space between them.

Figure 8 represents the same construction as Figure 7, only from another point of view; the frame is not drawn.

Figures 9 and 10 represent two views of a circle of straight magnets or electro-magnets placed with their ends inserted into and supported by two circular rings or discs, metallic or otherwise, as wood or paper, supported by an axle A from which it is insulated; this magnetic wheel is turned by the handle H or by power.

Figs. 11 and 12 represent another construction of the magnetic wheel, one circle of the permanent or electro-magnet being fixed round, say an iron disc D, D, which is secured to but insulated from the axle A, A, which is turned by the handle H, while the outer circle of permanent or electro-magnets are secured to a metallic or other ring C, C, C, C, secured to the frame L, L.

Fig. 13 represents a large electro-magnet having its poles curved inwards at T, T, to which are secured 2 cups C, C, and C, C, which form the respective poles, and between which an iron disc or an electric-magnetic wheel D, *d, d, D*, is made to revolve by a handle at H or by power, its axle passing through the centres of these cups. The outer end of the axle is shewn carrying a revolving commutator R, R, with its commutating wires *a, a, a*, and *b, b, b*, and its frame L, detailed more fully under Fig. 20.

Figs. 14 and 15 represent a wheel, the spokes S S, S S, S S, S S, S S, and tyre *t, t, t, t*, of which expand and contract as it revolves. Fig. 14 represents this wheel stationary and unweighted; Fig. 15 represents it weighted and as it appears when in motion; Figs. 16 and 17 shew the manner in which the ends of the spokes are respectively secured to the tyre *t, t, t, t*, and nave N of the wheel by the pieces A and B, Figs. 16 and 17, which hold the outer ends of the spokes S, S, together by means of the screws and nuts S and S¹, the difference being that A is by preference rivetted to the tyre *t* while B is secured to the nave N by being screwed by preference into a nut inserted sideways into N.

Fig. 18 represents an insulated coil *c* wound on a solid iron-bar magnet which is fixed at *a, a*, solidly to a locomotive frame, not drawn, by brass or gun-metal fastenings, but placed a sufficient distance from it not to interfere with the attraction; at each end or pole of this magnet is attached an ordinarily shaped wrought-iron railway wheel W, W, but of lighter construction, by means of which the magnetism of the poles is conveyed to the rails and the wheels W, W, and W, W, are by this

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arrangement made to bite or hold the rails firmly; by another construction the wheels W, W, and W, W, are fixed solidly to the ends of the magnets, and the magnet revolves with them; the coil is then also wound on the magnet so as to lie up and be packed against the wheels W, W, which are centrally made in a disc form so that the coil shall fit close against it.

Figure 19 represents a horse-shoe electro-magnet secured to the side of the frame of a locomotive, so as to approach close to and attract the rail; M is the magnet which is placed between the two wheels W, W, of the frame F, F, of a locomotive to which it is secured, so as to not to interfere with its magnetic action; the poles of these magnets are by preference furnished with small wheels W, W, W, and W, W, W, which are secured in boxes made to slide up and down grooved or bevelled slots, B B, B¹ B¹, cut in the magnet poles, and are kept downwards by the coiled springs S, S, fixed above them in the same slot; these wheels S, S, S, may be either placed or secured within the poles of the magnets by dividing them, or else they may be fixed outside them. By another arrangement the magnet is so attached to the locomotive frame that it can itself move up and down on meeting obstacles, the sides of the poles being furnished with guards.

Fig. 20, M, M, represents a magnet on which there is wound an insulated coil R, R; D, D, is a drum or disc made of wood, ebonite, or other non-conducting material, having two brass rings attached to it, one on each side; from these rings project the pieces of wire or metal a, a, a, a, a, a, and b, b, b, b, b, b, respectively, which are imbedded in the drum D, D; these wires are placed alternately apart, so as both to avoid touching each other and the ring opposite to them; the terminals of the coil R, R¹, are attached to the rollers d and d¹ which are secured in a frame of non-conducting material which is fixed over the drum D, D, so that the roller d, as shewn in the Figure, rests on the wire or slip of metal b, while the roller d¹ rests on the wire a. The rings are respectively placed in connection with the poles of a battery by means of the wires t, t, and t¹, t¹; as the drum revolves by turning the handle H the wires on it will advance forward and the rollers d and d¹ will run on to the next pair of wires, and the roller d which before was resting on the wire b will now thus rest on the wire a, while the roller d¹ will rest on the wire b, and thus as the drum rotates there will be a constant change of the poles of the magnet M, M.

Fig. 21 represents a ring flattened by preference, composed of a core either of solid iron or of strong iron wire and of a coil of insulated copper wire built up with alternate layers of thin sheets of iron wound round it, the shaded line in the lower Figure, drawn in section, represents this sheet iron; the spaces between them represent the wire. In the upper Figure the iron wire A, B, is shown drawn longitudinally, while the insulated copper wires c, d, and the iron sheets lying between them are shewn cut across. The whole of the magnetic ring R, R, is incased in thin sheet iron; by this means as it revolves between the poles of a magnet constructed so as to embrace it the whole magnetic influence is exercised, owing to the iron forming the magnet being brought into close contact instead of being removed from the poles of the magnet within which it revolves by the distance of the space occupied by the copper wire, which defect in the grammes' clever and otherwise perfect electro-magnetic machine it is hoped that this arrangement may rectify.

Figure 22, M, M, M, represents a large electro-magnet with its coils C and C¹ and its saucer or semi-globular-shaped poles t, t, t, t, and t¹, t¹, t¹, t¹, within which poles the semi-globular poles b, b, b, b, and d, d, d, d, of the electro-magnet D, D, revolve almost in contact with them, the insulated wire on this latter is coiled round its body in the direction D, D. The semi-globular-poled magnet D, D, is supported on the axle a, a, and is turned by the handle H, or by a pulley if an engine is used. Commutators such as are shewn at Figure 20 are applied to the terminals of the coils on either or both magnets in conjunction with a galvanic battery.

Figure 23, M, M, represents a large permanent or electro-magnet with its curved arms C, C¹; a, a, a, a, a, a, a, a, are small straight electro-magnets secured by one end into a common centre consisting of an iron disc D; the other ends are made

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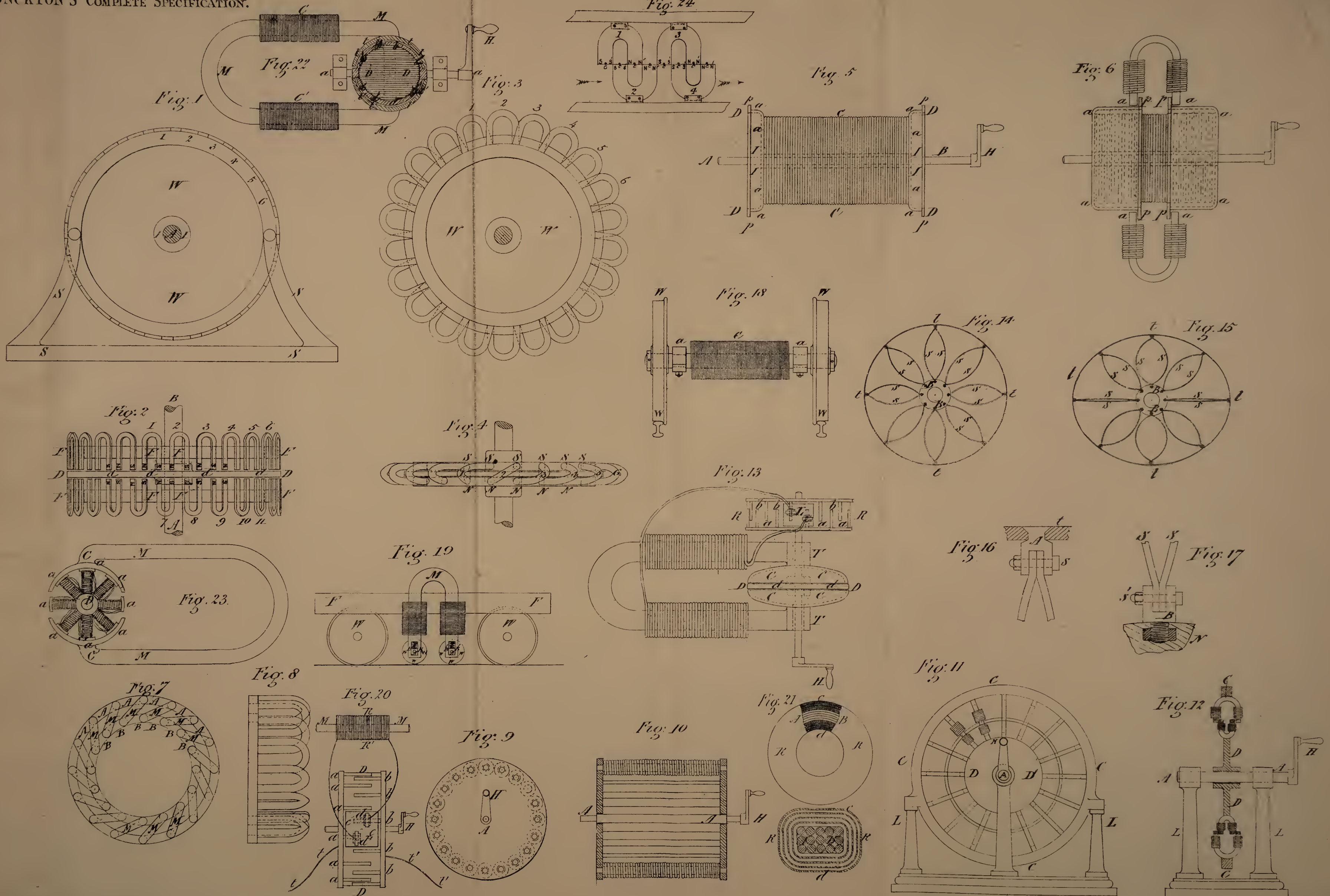
large and curved, so as to lie almost in contact within the circle formed by the arms of C and C¹ of the large magnet M, M; the disc D is supported by and affixed on to an axle from which it is insulated, and is turned by a handle or by a pulley. The coils on the magnets a, a, a, a, a, a, a, a, are all joined up together, their
5 terminals being joined up to a break or commutator in connection with the poles of a battery.

Figure 24, magnets 1 and 3, are fixed in a circle and are stationary, while magnets 2 and 4 which are fixed on a wheel rotate past them and their poles in close proximity, as shown in the Figure. The magnets and their poles are all made
10 of the same size and width, the poles occupying the same space as the distance between the poles of each magnet; it is obvious that the poles S¹ and S¹ of magnets 1 and 2 are repelling each other while simultaneously the poles S¹ and N of the same magnets 2 and 1 are attracting each other. In like manner poles N¹ and N of magnets 1 and 2 are repelling each other while poles N¹ and S of magnets 2 and 3
15 are attracting each other; and in like manner poles S¹ and S of magnets 3 and 4 are repelling each other while poles S¹ and N of magnets 4 and 3 are attracting each other while poles N¹ and N of magnets 3 and 4 are simultaneously repelling each other, and so on all round the circle; when the poles c, c, c, c, of the rotating magnets pass the centres of attraction of the poles c, c, c, c, of the fixed magnets the current is
20 reversed, and the poles which previously attracted now repel each other and the poles that previously repelled now attract. It is also obvious that the motion of the rotating magnet cylinders can be reversed by reversing the electric current, which will at once change attraction into repulsion and repulsion into attraction in the opposite direction; as many rotating magnetic wheels as may be desired may
25 be similarly applied to the same axletree to be actuated by corresponding fixed magnets, and the distance of the polar attraction or repulsion be thereby diminished and sub-divided. The advantages are that every magnet is doing its utmost duty without loss of current in the closest possible proximity, and thus utilising profitably and to the utmost both the quantity and intensity of the electro-magnetic currents.
30 The magnetic circles shewn in Figures 1, 2, 3, and 4, can be thus utilised by removing the discs.

I disclaim to knowingly make use of the Inventions of others, and I claim without confining myself to any particular form of construction, so long as the principles of the Invention are adhered to, my improvements in generating and
35 applying the electric current and in producing motive power, and in the apparatus necessary for carrying the same into effect, substantially as herein-before described and shewn in the Drawings.

In witness whereof, I, the said Edward Henry Cradock Monckton, have hereunto set my hand and seal, this Twentieth day of November, in the year of our Lord One thousand eight hundred and seventy-six.

E. H. C. MONCKTON. (L.S.)



The filed drawing is not colored.

